TEI INC.
SPECIAL SYSTEMS GROUP
HOUSTON, TEXAS

MCS
MICROCOMPUTER SYSTEM

TEI SYSTEM SOFTWARE AND UTILITY

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TDOS uses two 1K proms to handle all system IØ. The prom that handles Disk I/O is at FØØØH to F3FFH. The prom that handles all other I/O is at F400H to F7FFH. The 512 BYTE area of CBIOS in TDOS is open for user use. All that resides in the CBIOS area of TDOS is the jump table to the proms.

The TEI jump vector for the proms are shown below, the address are given to the left.

```
F000 to F3FF Prom
F000  JMP   COLDBOOT; Cold Start Load
F003  JMP   GOCPM;    Arrive Here After Cold Start Load
F006  JMP   WBOOT;    Warm Start Load
F009  JMP   HOME;     Move to Track 00
F00C  JMP   SELDSK;   Select Disk Drive
F00F  JMP   SETTRK;   Set Track Number
F012  JMP   SETSEC;   Set Sector Number
F015  JMP   SETDMA;   Set DMA Read/Write Buffer
F018  JMP   READ;     Read Selected Sector
F018  JMP   WRITE;    Write Selected Sector
F01E  JMP   READTRK;  Read Selected Track Starting at Selected Sector
F021  JMP   WRITETRK; Write Selected Tract Starting at Selected Sector
F400  TO F7FF  PROM

F7E2  JMP XY Plot     Plot character Direct to Video

F7E5  JMP   BSYLT;    Turn the Busy Lite On, On the TEI Keyboard
F7E8  JMP   INITU;    Initialize Usuary for Printer
F7EB  JMP   MESAG;    Outputs Message to Video
F7EE  JMP   READER;   Read Character From Punch - Not Used
F7F1  JMP   PUNCH;    Write Character to Punch - Not Used
F7F4  JMP   LIST;     Output Character to Printer
F7F7  JMP   CONOUT;   Output Character to TEI Video
F7FA  JMP   CONIN;    Read Console Character In
F7FD  JMP   CONST;    Check For Console Character Ready and Turn Ready
                      Lite On, On TEI Keyboard
```

COLDBOOT — The COLDBOOT is the system loader. It sends the sign on message and loads the CP/M into memory. The COLDBOOT calls routines in the second prom.

GOCPM — The entry point after a boot sets up system parameters and turns control over to TDOS. System parameters that are set up
Location 0,1,2 JMP WBOOT
Location 5,6,7 JMP BDOS
Set buffer pointer (DMA) to 80H

WBOOT — The entry point for warm boot. Reads the CP/M into memory from A drive except for the BIOS. Then jumps to GOCPM.

HOME — Returns to disk head of the currently selected disk to track 00.

SELDSK — Sets the disk drive to be selected. The drive is not selected until a disk operation occurs. The input information is passed in register C. A Ø for A drive a 1 for B drive.

SETTRK — Sets the track number for the next disk operation. The information is passed in register C. The track is not selected until a read or write of the disk occurs.

SETSEC — Register C contains the sector number for subsequent disk accesses. The sector is not selected until a read or write of the disk occurs.

SETDMA — Registers B (high order) and C (low order) contain the DMA (direct memory access) for subsequent read and write operations.

READ — Assuming the drive, track, sector and DMA have been set, will read the selected sector. It will return a 00 in register A if the read is good or 01 if read is not completed properly. If the drive cannot be selected, the system prints out: DISK NOT READY and then waits until disk is made ready. Causes for the disk not being ready are:
(1) Disk drive not turned on
(2) Diskette not in drive
(3) Diskette in drive is upside down

WRITE — Will write the data from the currently selected DMA address to the selected drive sector and track. An error message will be displayed if the diskette is

WRITE PROTECTED

All other information and errors are the same as read.

READTRK — Assuming the drive, track, sector, and DMA are set, will read the data from the sector set to the last sector on the track sequentially. No remapping of sectors and tracks is done for the mini.

WRITTRK — Write the data from the selected DMA address to the end of the selected track starting from the selected sector sequentially no remapping of sectors and tracks is done for the mini.

XY PLOT — Registers D and E contain the X and Y locations of the character to be plotted. Register C contains the character to be plotted. X must be between 0-79 and Y must be between 0-23. Location 0, 0 will plot in the upper left hand corner of the screen, after a clear screen has been done.

BSYLT — This routine turns the busy light on, on the TEI keyboard. It utilizes out port Ø1.

INITU — This routine is the initialize and programs the USART to be used for the printer. This rountine is called only in the COLDBOOT LOAD. It utilizes Ports 02,03,04,05,06 and 07.

MESAG — Register H and L contain the starting address of a message, which is to be output to the video display. The message must end with A 00. This is used by most of the disk I/O functions for errors and the system sign on message.

READER — To be used for the paper tape reader. Not used at this time.

PUNCH — To be used for the paper tape punch. Not used at this time.

LIST — Sends the character from the C register to the printer. There is a short delay loop for the carriage return (ØDH). Use I/O ports 02 and 03,for serial printer or 04,05,06 and 07 for parallel printers. Type of printer is set in the I/O bite. Default is for parallel printers.

CONOUT — Sends the character in the C register to the TEI monitor. The character is in ASCII, high order parity bit will be set to zero. Special control character used by the video software are:

01H; Turn Cursor On or Off
08H; Back space Cursor (←)
0AH; Line Feed Cursor (↓)
0BH; Vertical Move Cursor (↑)
0CH; Move Cursor Right (→)
0DH; Carriage Return
11H; Clear Screen Leave Protected Data
12H; Protected Field Switch
1AH; Clear Total Screen

CONIN — Reads the next console character into the A register, with the high order bit set to zero. Will wait if no console character is ready. Uses input port 01H.

CONST — Sample status on the console device and returns an ØFFH if a character is ready to read and 00H if no console character is ready in register A. Uses input port ØØH. It also turns on the ready light on the TEI keyboard.

Also see the CP/M alteration guide for further information.

2 TEI MEMORY MAP

The TEI memory map with TDOS reserves page zero of the main memory map, that is ØØH to ØFFH. See pages 17-19 of the system alteration guide. TEI special usages in page zero are:

LOCATION	CONTENTS
10H-12H	Interrupt Location 2. Used by the TEI floppy disk controller for restart after a read or a write.
40H-41H	The address of the base of CP/M
42-43H	The address of the start of the DMA
44H	The currently selected disk drive.
45H	The disk drive to be used on the next disk operation.
46H	The track to be used on the next disk operation.
47H	The sector to be used on the next disk operation.
48H	The current type of disk drive. Zero (0) is for an 8 inch floppy, 800 or 850 drive type. One (1) is for a 5 inch mini floppy, 400 or 450 drive type
49H-4CH	Used to store the current track location of the disk drive head of unceledted disks for drives A-D, or 0-3.
4DH	The type of disk drive which is A drive. The same rules as for 48H.

Other memory used by the TEI System is FØØØH-F7FFH for system I/O proms. F8ØØH-FFFFH is used for TEI video controller screen memory.

TDOS provides three utilities for handling disk formating, copying and erasing, plus two memory tests.

3.1 COPY

The copy program does a high speed disk copy from any disk drive to any other disk drive. It will also copy certain sections of a disk to another disk. Copy will run until it encounters the last specified track or until it reads a complete track of E5H. E5H is the indicator for an empty raack. No carriage returns are required unless specified. The copy sign on message and input follows:

```
COPY VERS m.m
     ENTER DISK DRIVE LETTER ONLY

     SOURCE ? i

     DESTINATION ? j

     COPY OPTIONS

        1) TOTAL DISK
        2) SYSTEM ONLY
        3) DIRECTORY AND DATA ONLY

     WHICH OPTION (1-3) ? k

     COPYING FROM DISK DRIVE i to DISK DRIVE j

     PRESS RETURN TO CONTINUE
     PRESS SPACE BAR TO ABORT
```

m.m is the version of copy in use

i is the disk drive on which the disk is to be copied from.

j is the disk drive on which the disk is to be copied to.

k is the part of the diskette that is to be copied.

Pressing the return key will cause the copy program to start. Pressing the space bar or any other input key will cause the system to reboot with no disk copy.

3.2 FORMAT

The format program does a high speed diskette format for the IBM 3740 format-128 BYTES/Sector. No carriage returns are required unless specified. The format sign on message and input follows:

```
     FORMAT VERS m.m

     ENTER DISK DRIVE LETTER ONLY
     DRIVE ON WHICH DISK IS TO BE FORMATED ? i
```

```
DISK ON DRIVE i IS TO BE FORMATED

PRESS RETURN TO CONTINUE
PRESS SPACE BAR TO ABORT
```

NOTE THAT FORMAT WILL DESTROY ALL INFORMATION ON A DISKETTE.

m.m is the version of format program.

i is the letter of the disk drive on which the diskette is to be formated.

3.3 ERACE

The erase program will write an ØE5H (IBM empty data) for every data BYTE for the complete diskette. Sign on message and input follows:

```
ERASE VERS m.m

ENTER DISK DRIVE LETTER ONLY
DRIVE ON WHICH DISK IS TO BE ERASED? i

DISK ON DRIVE i IS TO BE ERASED

PRESS RETURN TO CONTINUE
PRESS SPACE BAR TO ABORT
```

m.m is the version of the erase program

i is the letter of the disk drive on which the diskette is to be erased.

3.4 TEST, TESTØ

There are two memory test programs. TEST will test all of memory from 0 to the top of CP/M. The program resides from 100H-600H and check memory from 1000H to the top of CP/M. Then part of the program moves to 3E00H and checks memory from 0000H to 2000H. The sign on follows.

```
TOTAL MEMORY DIAGNOSTIC
VERS m.m
STARTING AT 0000H ENDING AT kkkk

RUNNING
```

Memory TESTØ is a relocatable memory test for testing specific blocks of memory. The input to the memory test is the starting location of the program. The starting and ending memory locations of the test in HEX. All memory locations are four digit HEX numbers (0-F). The sign on message and input follow.

```
MEMORY DIAGNOSTIC
VERS m.m

RELOCATABLE PROGRAM
INPUT ADDRESS IN HEX - 4 DIGITS ONLY
NEW STARTING LOCATION OF PROGRAM?  hhhh
```

START ? iiii

END ? jjjj

RUNNING

m.m is the version number

hhhh is the starting location of the program. This must be either 0400H or greater than 06FFH.

iiii is the input for the starting memory location of the test. iiii must be at least 300H greater than hhhh or 200H less than hhhh

jjjj is the input for the last memory location of the test. jjjj must be at least 0100H greater than iiii.

kkkk is the top of CP/M

Upon successful completion of the test

DONE
PRESS RETURN TO CONTINUE

is displayed. After pressing return the system will display the COLDBOOT sign on message.

If there are errors then the bit pattern in HEX that was read is displayed, and the bit pattern in HEX that was written is displayed, followed by the bad address. Each display has a heading

READ WRITTEN ADDRESS

followed by the errors. If there are more than 20 errors then

PRESS RETURN TO CONTINUE

is displayed. After pressing return the next 20 errors are displayed until all errors are displayed.

4.1 The floppy disk is a standard IBM 3740 format with 128 BYTES/Sector, 77 tracks 26 Sectors/Track

	Number of BYTES	Hex Value of BYTE Written
	40	FF
	6	00
	1	FC (Index Mark)
	26	FF
*	6	00
	1	FE (ID Address Mark)
	1	Track Number (0-4C)
	1	00
	1	Sector Number (1-1A)
	1	00
	1	F7 (2 CRC's Written)
	11	FF
	6	00
	1	FB (Data Address Mark)
	128	Data (E5)
	1	F7 (2 CRC's Written)
	27	FF
	**247	FF

*Written 26 times, bracketed field

**Maybe more or less but till the end of the track

4.2 TEI mini floppy format 128 BYTES/Sector 18 Sectors/Track 35 Track/Diskette

	Number of BYTES	Hex Value BYTE Written
	26	FF
	6	00
*	1	FE (ID Address Mark)
	1	Track (0-22)
	1	00
	1	Sector (1-12)
	1	F7 (2 CRC's Written)
	11	FF
	6	00
	1	FB (Data Address Mark)
	128	Data (E5)
	1	F7 (2 CRC Written)
	11	FF
	6	00
	**247	FF

*Written 18 times, bracketed field

**Maybe more or less but till end of track

MINI FLOPPY SOFTWARE

The mini floppy disk system requires different system software, because of the different disk format. The functions performed by the software is the same as the large disk system. The special programs used by the mini floopy are MSYSGEN, MCOPY, MERASE, MFORMAT and MMOVCPM

A special program MSGLCOPY is provided for disk to disk copy on a single disk system. See section 9.3 for details.

TEI SYSTEM I/O PORTS

The TEI computer system uses the following I/O Ports

Ports in Hex	FUNCTION
00-01	Keyboard Console
02-03	Printer - RS232
04-07	Printer-Parallel
08-0F	Reserved
40-4F	Reserved
7F	Ram Paging
80-85	Disk Controller
90-9F	Video Controller
F0-FD	Reserved
FE-FF	Function Keys On Keyboard

7 NON-STANDARD TEI SYSTEM

7.1 All that is required to bring up a TEI disk drive system for a non-standard TEI I/O system is to burn one 2708 prom for the system I/O. The console and other non-disk I/O is in the prom residing at F400 to F7FF as described in Part 1 of this section. The prom must contain the JMP table between F7E2 and F7EE, and the CONST, CONIN, CONOUT and MESAG routines. The BSYLT, INITU, XYPLOT READER, PUNCH and LIST routines must be returns (RET).

A sample for the standard and non-standard I/O prom programs follow this section.

Special note- the floppy disk controller board reads the prom data inverted. In other words, a NOP is 00H, but must be burned into the prom as a FFH. The whole program must be complemented (CMA) before the prom is burned.

8 SYSTEM START UP

To start up the system follow these steps:

1. Turn the power on for all units of the system
2. The sign on message will be output

   T/DOS VERSION 1.4

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   LOAD DISK & PRESS RETURN

3. Load the system diskette into disk drive A, with the label towards the disk drive door handle. On the mini floppy, this is to the right and on the large floppy, this is facing down. Close the disk drive door and press return.
4. The disk drive will start running and the red light on Drive A will come on. The following message will be displayed.

   XX K CP/M VERS m.m

   A>

   XX is the System size
   m.m is the version of CP/M

5. The A> means that you are now in CP/M and ready for command input.
6. Whenever a disk is changed under CP/M a Control/C must be entered to REBOOT the system, if not done the data on the disk might be destroyed.
7. If the system must be COLDBOOTED again, press the reset for one second. The system will promot with the SIGNON message.

9 DISK TO DISK TRANSFER ON A ONE DRIVE SYSTEM

Transfer of programs from one disk to another is a small problen on a one disk drive system. To transfer programs requires patience and care on the part of the user. Paragraph 9.1 described below is one method to bring up a new disk and add some standard programs to it. The example is for a mini disk system.

1. Bring up the system as described in Section B.
2. Enter MFORMAT and press return.
3. Remove the original diskette and place the new diskette in the drive.
4. Answer the question: DRIVE ON WHICH DISK IS TO BE FORMATED? with an "A"
5. Press return.
6. When:
   DONE
   FORMATED DISK ON DRIVE A SYSTEM IN A HALT PAAEARS, remove the new diskette in the drive.
7. Press the reset button or key and hold for 2 seconds, restart the system as described in Section 8.
8. Now put the CP/M system on the new diskette. Enter MSYSGWN and press return.
9. Answer the question: SOURCE DRIVE NAME with an A.
10. Press return.
11. Remove the original diskette and replace it with the new diskette.
12. Answer the question: DESTINATION DRIVE NAME with an A
13. Press return
14. Press return again
15. The system should respond with A>
    If not, repeat from Step 8. The CP/M system is now on the new diskette.
16. Remove the new diskette and replace it with the original diskette.
17. Press the control key (CTRL) and the Ckey simultaneously. The system will respond with^C.
18. For an example, we will move ED.COM to the new diskette. Enter: DDT ED.COM Press return.
19. The system will respond with: DDT VERS 1.4
    NEXT PC
    1900 100
20. Note that the program resides in memory from 100 to 1900 Hex. The program size is 1800 Hex or 24 pages. One page is 100 Hex. Remove the original diskette and replace it with the new diskette.
21. Enter a control C, as described in Step 17.
22. The System will respond with: A>
    Enter: Save 24 ED.COM
    Press Return
23. ED.COM is now on the new disk. Remove the new diskette and replace with the original diskette. Repeat from Step 17 for each command program that is to be transferred.

9.2 Transfer of basic programs is relatively easy, but care must be taken to avoid destroying a disk. [Program Name] is the name of the basic program to be transferred without the secondary name of .BAS

1. Enter basic to transfer basic programs
2. Enter: LOAD"[Program Name]
3. Remove original diskette and replace with new diskette
4. Enter: RESET
5. Enter: SAVE" [Program Name]
6. Remove new diskette and replace with original diskette
7. Enter: RESET
8. Repeat from Step 2 for each program to be transferred.

9.3 MSGLCOPY

The MSGLCOPY program is used to do a total disk to disk copy on a single disk drive mini system. The program can be loaded from one diskette and used to copy another diskette. Basically all the program does is load as much information as will fit in memory from one diskette, let you change diskettes and writes the information back out. This is done as many times as required, to copy the entire diskette. The disk that is to be copied to must already have been formated.

For a nominal charge, TEI, Inc. will make available to properly registered purchasers of TEI Softwares any new or improved software versions.

10 WRITE PROTECTED DISKETTES

All TEI Disk Drive Systems have a write protect function. The large 8" floppy diskette has a notch on the right-hand side of the bottom edge. If this notch is covered so no light shines through, the diskette is NOT write protected. When the notch is uncovered, the diskette is write protected.

The Mini Floppy Diskette has a notch on the right-hand edge. If this notch is covered so no light shines through, the diskette is write protected. If the notch is uncovered, the diskette is NOT write protected.

Please Note: The procedure on the large diskette and the Minidiskette is exactly opposite.

II I/O BYTE AND PRINTERS

The TEI System I/O BYTE is in the standard CP/M location. See the CP/M system alteration guide and CP/M features and facilities for details For the uses of the I/O BYTE. The default value for the TEI I/O BYTE is C1H.

Values for the TEI I/O BYTE follow

CONSOLE (0,1)

0 - Output is TTY, input is keyboard.
* 1 - Output is CRT
2 - Output is to list device and CRT
3 - Not used

READER (2,3)

* 0 - Input is keyboard
1,2,3 - Not used

PUNCH (4,5)

* 0 - Output is TTY
1,2,3 - Not used

LIST (6,7)

0 - TTY
1 - CRT
2 - Not used
* 3 - Parallel Printer

The TTY is a serial device on ports 2,3
The parallel printer is on ports 4,5,6,7
The Keyboard is on ports 0,1
The CRT is located in memory between F800H - FFFFH

* I/O BYTE DEFAULTS.

UNDER NORMAL OPERATION, THE USER INTERACTS WITH THE CP/M CONSOLE COMMAND PROCESSOR (CCP) FOLLOWING THE SIGN ON PROMPT. CP/M VERSION 1.4 SUPPORT AN "AUTO LOAD" FEATURE, WHICH WILL ALLOW THE USER TO CAOSE AN INITIAL PROGRAM TO BE LOADED BEFORE SIGN ON.

UNDER NORMAL OPERATION, THE CCP RECEIVES CONTROL FROM THE BIOS UPON A WARM OR COLD START. THE BEGINNING OF THE CCP MODULE (2900H IN 16K CP/M) CONTAINS A TWO ELEMENT JUMP VECTOR, AND A COMMAND LINE WHICH TAKES THE FORM:

```
CCP:  JMP  CCP START:  START THE CONSOLE PROCESSOR
      JMP  CCP CLEAR:  CLEAR THE INITIAL COMMAND
      DB   127       : MAXIMUM COMMAND LENGTH
CL:   DB   Ø         : COMMAND LENGTH
      DB   '      '   : 8 BLANK CHARACTERS
      DB   '      '   : 8 BLANK CHARACTERS
      DB   COPYRIGHT ...            COPYRIGHT NOTICE
```

IF CONTROL TRANSFERS TO LOCATION CCP, THE CONSOLE PROCESSOR EXAMINES THE COMMAND LENGTH AT CL. IF THE COMMAND LENGTH IS ZERO, THEN THE USER RECEIVES THE SIGN ON PROMPT. IF CL IS NON-ZERO, THEN IT IS TAKEN AS THE LENGTH OF THE INITIAL COMMAND WHICH FOLLOWS. THE USER MUST INCLUDE THE INITIAL COMMAND LINE TO EXECUTE IN THE 127 BYTE COMMAND LINE WHICH FOLLOWS THE CL BYTE. ALTHOUGH ONLY 16 BLANK SPACES ARE PROVIDED IN THIS AREA, THE DIGITAL RESEARCH COPYRIGHT NOTICE CAN BE MOVED TO OBTAIN MORE SPACE.

IF THE COMMAND LENGTH CL IS NON-ZERO, THEN THE INITIAL COMMAND WILL BE EXECUTED ON EACH COLD START IN THE TEI SYSTEM. IF CONTROL IS INITIALLY TRANSFERRED TO CCP + 3 (JMP CCP CLEAR), THE INITIAL COMMAND LINE IS IGNORED. THE TEI SYSTEM JUMPS TO CCP + 3 ON WARM STARTS (C) WHICH WILL IGNORE THE COMMAND LINE.

THE EASIEST WAY TO INSERT THE COMMAND LINE INTO YOUR OPERATIING SYSTEM IS TO CREATE A NEW MOV CPM COMMAND. THE FOLLOWING EXAMPLE IS FOR AUTO-LOADING TEI SUPER BASIC. THE COMMAND LENGTH (CL) IS LOCATED AT A07H, THIS VALUE WILL BE 05H, THE NEXT FIVE BYTES SPELL OUT BASIC IN ASCII AND THE REST OF THE BYTES ARE ZERØED OUT. THE NEW MOV CPM COMMAND IS SAVED AS MOV CPM 1 COM. A MOV CPM1 AND SYSTEM ARE THEN DONE TO LOAD A NEW 32K OPERATING SYSTEM WITH AUTO-LOAD OF BASIC ON THE SYSTEM TRACKS.

IF CONTROL TRANSFERS TO LOCATION CCP, THE CONSOLE PROCESSOR EXAMINES THE COMMAND LENGTH AT CL. IF THE COMMAND LENGTH IS ZERO, THEN THE USER RECEIVES THE SIGN ON PROMPT. IF CL IS NON-ZERO, THEN IT IS TAKEN AS THE LENGTH OF THE INITIAL COMMAND WHICH FOLLOWS, THE USER MUST INCLUDE THE INITIAL COMMAND LINE TO EXECUTE IN THE 127 BYTE COMMAND LINE WHICH FOLLOWS THE CL BYTE. ALTHOUGH ONLY 16 BLANK SPACES ARE PROVIDED IN THIS AREA, THE DIGITAL RESEARCH COPYRIGHT NOTICE CAN BE MOVED TO OBTAIN MORE SPACE.

IF THE COMMAND LENGTH CL IS NON-ZERO, THEN THE INITIAL COMMAND WILL BE EXECUTED ON EACH COLD START IN THE TEI SYSTEM. IF CONTROL IS INITIALLY TRANSFERRED TO CCP + 3 (JMP CCP CLEAR), THE INITIAL COMMAND LINE IS IGNORED. THE TEI SYSTEM JUMPS TO CCP + 3 ON WARM STARTS (C) WHICH WILL IGNORE THE COMMAND LINE.

```
A DDT MOVCPM.COM
DDT VERS 1.4
NEXT PC
2400 0100
-DA00, A3F
0A00 C3 55 03 C3 51 03 7F 00 20 20 20 20 20 20 20 20 .U..Q...
0A1G 20 20 20 20 20 20 20 20 43 4F 50 59 52 49 47 48        COPYRIGHT
0A20 54 20 28 43 29 20 31 39 37 38 2C 20 44 49 47 49 T (0) 1978, DIGIT
0A30 54 41 4C 20 52 45 53 45 41 52 43 48 20 20 00 00 TAL RESEARCH ....
SA07
0A07 00 05  07
0A08 20 42  42
0A09 20 41  3A
0A0A 20 53  42
0A0B 20 49  41
0A0C 20 43  53
0A00 20 0   49
0A0E 20 0   43
0A0F 20 0
0A10 20 0
0A11 20 0
0A12 20 0
0A13 20 0
0A14 20 0
0A15 20 0
0A16 20 0
0A17 20 0
0A18 43 .
0A00,A3F                                                    B:BASIC
0A00 C3 55 03 C3 51 03 7F 05 42 41 53 49 43 00 00 00 .U..Q...BASIC....
0A10 00 00 00 00 00 00 00 00 43 4F 50 59 52 49 47 48.........COPYRIGHT
0A20 54 20 28 43 29 20 31 39 37 38 2C 20 44 49 47 49 T (0) 1978, DIGIT
0A30 54 41 4C 20 52 45 53 45 41 52 43 48 20 20 00 00 TAL RESEARCH
-^C
A>SAVE 35 MOVCPM1.COM
A>MOVCPM1 32 *
CONSTRUCTING 32K CP/M VERS 1.4
READY FOR "SYSGEN" OR
"SAVE 32 CPM32.COM
A>SYSGEN
SYSGEN VER 1.4
SOURCE DRIVE NAME (OR RETURN TO SKIP)
DESTINATION DRIVE NAME (OR RETURN TO REBOOT) A
DESTINATION ON A, THEN TYPE RETURN
FUNCTION COMPLETE
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)
```

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MIX DRIVE SYSTEM

13.1 CP/M is provided either on a Mini Diskette or a Standard Diskette and must be modified for a Mixed Drive System. To create a Mixed Drive System requires replacing the current CBIOS with new CBIOS. To do this requires a diskette that contains the following items:

(1) CP/M - OPERATING SYSTEM
(2) MOVCPM.COM
(3) SYSGEN.COM or MSYSGEN.COM
(4) ASM.COM
(5) DDT.COM
(6) ED.COM
(7) CBIOSDRV.ASM

The program CBIOSDRV.ASM must be edited for the system size and disk configureation required. The system size is set in kilobytes by the label MSIZE. The drive types are set in a table that begins with label drive A and ends with label drive D. The drive type is set with a number between 0 and 4.

DRIVE TYPE	VALUE
No drive	0
800	1
400	2
850	3
450	4

After the edit of CBIOSDRV.ASM to the prefered size and type, it must then be assembled. Create a copy of the prefered operating system size by using the MOVCPM Command and save it as a COM file.

The new CBIOS and operating system must then be merged together using DDT.COM. Load DDT.COM and the CP/M command file, then input the CBIOS DRV.HEX file using the one of the following read biases.

MEMORY SIZE	BIAS IN HEX
32K	A080
40K	8080
48K	6080
56K	4080
60K	3080
64K	2080

When this is complete exit to CP/M then use the SYSGEW to place the patched memory image back on to the diskette. If there are problems see the example for setting up a PT-408 type system at the end of this section. For further help read the CP/M SYSTEM ALTERATION GUIDE SECTION 3. SECOND LEVEL SYSTEM GENERATION. Appendix D contains a listing of CBIOSDRV.ASM.

13.2 The disk parameter section is located near the beginning of the BDOS. The logical to physical sector translation table is located at BDOS + 1AH, in a 32K system this is at 711AH. The parameters which follow the translation vector define the exact diskette characteristics. The parameters for this block are listed in appendix E.

SECSIZ: The number of sectors on each track.

DIRMAX: The maximum directory number.

BLKSHF: Indirectly determines the number of sectors per block.

$_2$ BLKSHF = SECTORS/BLOCK

BLKMSK: Is derived from BLKSHF as $_2$ BLKSHF - 1.

OSTRKS: Determines the number of operating system tracks and effectively removes these tracks from the usable directory and data area.

MAXALL: Is computed from the block size and the remaining usable tracks after OSTRKS are subtracted from the total number of available tracks.

((77 - 2) tracks *26 sectors/track)/8 sectors/block

= 243.75 blocks.

MAXALL = 242 maximum allocation number.

DIRBLK: Is a bit string which reserves the first blocks to hold the directory.

DIRBLK = 11ØØ ØØØØ = ØCØH

It should be noted that all these parameters are one BYTE in size, therefore none of them may be any larger than ØFFH or 255.

13.3 Certain programs are hardware dependent and can not be mixed between disk drives. MCOPY, MERASE, MFORMAT and MSYSGEN can only be used on the mini disks. COPY, ERASE FORMAT and SYSGEN can only be used on the standard disk system. MOVCPM.COM will only work on the type of diskette on which it was provided unless the disk parameter block is changed to the other disk system. An example of how to do this follows this section.

```
************** EXAMPLE OF SETTING UP A 48K PT-408 SYSTEM ***************

A>MSYSGEN                                                    orisinal disk in A
SYSGEN VER 1.4
MINI DISK
SOURCE DRIVE NAME (OR RETURN TO SKIP)A                       formated disk in B
SOURCE ON A,  THEN TYPE RETURN
FUNCTION COMPLETE                                            put 32K operatins
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)B
DESTINATION ON B, THEN TYPE RETURN                           system on B disk
FUNCTION COMPLETE
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)

A>PIP                                                        put these programs
*B:=A:MOVCPM.COM[V]                                          on B diskette
*B:=A:SYSGEN.COM[V]
*B:=A:ED.COM[V]
*B:=A:PIP.COM[V]
*B:=A:DDT.COM[V]
*B:=A:ASM.COM[V]

A>^C                                                         remove A diskette put
                                                             B diskette in A drive
A>PIP A:=B:CBIOSDRV.ASM[V]                                   put CBIOSDRV.ASM on
                                                             A diskette
A>ED CBIOSDRV.ASM                                            edit CBIOSDRV.ASM
*#A6T                                                        for a PT-408
;*************************************************************************
;               CBIOS FOR A PT-312                           load file display
;               MINI DRIVE ON A                              first 6 lines
;               STANDARD DRIVE ON B AND C
;               FOR FDC-2 DISK CONTROLLER BOARD
;
*L3KI                                                        edit headins
;               CBIOS FOR A PT-408                           use a control Z
;               MINI DRIVES ON A AND B                       to exit insert mode
;               STANDARD DRIVE ON C AND D
*6LT
MSIZE   EQU     32      ; SYSTEM SIZE IN KILOBYTES
*F3^Z-C2DI48^Z-LLT                                           chanse system size to
MSIZE   EQU     48      ; SYSTEM SIZE IN KILOBYTES           48K
*37L5T
DRIVEA  DB      2       ; DRIVE A
DRIVEB  DB      1       ; DRIVE B
DRIVEC  DB      1       ; DRIVE C
DRIVED  DB      0       ; DRIVE D
        ;
*LT                                                          chanse B drive to a
DRIVEB  DB      1       ; DRIVE B                            mini
*F1^Z-CDI2^Z-LLT
DRIVEB  DB      2       ; DRIVE B
*2LT
DRIVED  DB      0       ; DRIVE D                            chanse D drive to a
*F0^Z-CDI1^Z-LLT                                             standard
DRIVED  DB      1       ; DRIVE D
*E                                                           exit edit
```

```
A>ASM CBIOSDRV.AAZ
CP/M ASSEMBLER - VER 1.4                          assemble CBIOSDRV
BF02
005H USE FACTOR
END OF ASSEMBLY

A>MOVCPM 48 *                                     create a 48K CP/M
                                                  operating system
CONSTRUCTING 48K CP/M VERS 1.4
READY FOR "SYSGEN" OR
"SAVE 32 CPM48.COM"

A>SAVE 32 CPM48.COM                               save it

A>DDT CPM48.COM                                   load DDT and the
DDT VERS 1.4                                      saved 48K copy of
NEXT  PC                                          CP/M
2100 0100
-ICBIOSDRV.HEX                                    overlay the old CBIOS
-R6080                                            with the new CBIOS
NEXT  PC
2100 8E00
-^C                                               exit DDT

A>MSYSGEN
SYSGEN VER 1.4                                    put the new operating
MINI DISK
SOURCE DRIVE NAME (OR RETURN TO SKIP)             system on A drive
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)A
DESTINATION ON A, THEN TYPE RETURN
FUNCTION COMPLETE
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)      press the RESET button
                                                  reboot system a 408
                                                  operating system is not
                                                  in use
```

```
**************** EXAMPLE OF SETTING UP A 32K PT-312 ********************

A>MSGLCOPY                                  make a copy of the
MSGLCOPY VERS 1.2                           orisinal disk this
                                            will be the
LOAD DISK TO COPY FROM                      workins diskette
PRESS RETURN WHEN READY

LOAD DISK TO COPY TO
PRESS RETURN WHEN READY

LOAD DISK TO COPY FROM
PRESS RETURN WHEN READY

LOAD DISK TO COPY TO
PRESS RETURN WHEN READY

LOAD DISK TO COPY FROM
PRESS RETURN WHEN READY

LOAD DISK TO COPY TO
PRESS RETURN WHEN READY
DONE

T/DOS VERSION 1.41                          reboot system on the
COPYRIGHT 1977-TEI,INC                      new diskette

LOAD DISK & PRESS RETURN

32K CPM VERS 1.4

A>ERA MERASE.*                              remove these prosrams from
A>ERA MFORMAT.*                             the disk
A>ERA TEST?.*
A>ERA DUMP.*
A>ERA SUBMIT.*
A>ERA STAT.*

A>DDT                                       run DDT,remove diskette
DDT VERS 1.4                                insert second diskette
-ICBIOSDRV.ASM                              load CBIOSDRV.ASM
-R
NEXT  PC                                    insert workins diskette
0F00 0100
-^C                                         exit DDT

A>SAVE 14 CBIOSDRV.ASM                      save CBIOSDRV.ASM on
                                            on workins diskette
A>ASM CBIOSDRV.AAZ
CP/M ASSEMBLER - VER 1.4                    assemble CBIOSDRV
7F02
005H USE FACTOR
END OF ASSEMBLY

A>MOVCPM 32 *                                create a 32K CP/M
                                             operatins system
```

```
CONSTRUCTING 32K CP/M VERS 1.4
READY FOR "SYSGEN" OR
"SAVE 32 CPM32.COM"

A>SAVE 32 CPM32.COM                                    save it

A>DDT CPM32.COM                                        load DDT and the
DDT VERS 1.4                                           saved 32K copy of
NEXT  PC                                               CP/M
2100 0100
-ICBIOSDRV.HEX
-RA080                                                 overlay the old CBIOS
NEXT  PC                                               with the new CBIOS
2100 7E00
-^C                                                    exit DDT

A>MSYSGEN
SYSGEN VER 1.4                                           put the new operating
MINI DISK
SOURCE DRIVE NAME (OR RETURN TO SKIP)                    system on A drive
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)A
DESTINATION ON A, THEN TYPE RETURN
FUNCTION COMPLETE
DESTINATION DRIVE NAME (OR RETURN TO REBOOT)             press the RESET button
                                                         reboot system a 312
                                                         operiting system is now
                                                         in use
```

```
*** CHANGING FROM A MINI DISK MOVCPM.COM TO A STANDARD DISK MOVCPM.COM ***

A>ASM DSKP800.AAZ
CP/M ASSEMBLER - VER 1.4
0041
000H USE FACTOR
END OF ASSEMBLY

A>DDT MOVCPM.COM
DDT VERS 1.4
NEXT  PC
2400 0100
-IDSKP800.HEX
-R1200
NEXT  PC
2400 0000
-^C

A>SAVE 35 MOVCPM.COM
```

```
;*****************************************************************************
;               CBIOS FOR A PT-312
;               MINI DRIVE ON A
;               STANDARD DRIVE ON B AND C
;               FOR FDC-2 DISK CONTROLLER BOARD
;
;               24 JULY 78
;*****************************************************************************
;
;
MSIZE   EQU     32              ; SYSTEM SIZE IN KILOBYTES
TOP     EQU     MSIZE*1024      ; TOP OF CP/M, TOP OF RAM
PATCH   EQU     TOP-2*256       ; BASE OF CBIOS
BDOS    EQU     TOP-15*256      ; BASE OF BDOS
MEM1    EQU     BDOS+10H        ; LOCATION OF TRANSLATOR FOR LOGICAL TO
                                ; PHYSICAL SECTOR
MEM2    EQU     BDOS+3AH        ; LOCATION OF DISK PARAMETER BLOCK
        ;
        ;
        ;
        ORG     PATCH
      0 JMP     GOCPM
      3 JMP     WBOOT
      6 JMP     CONST
      9 JMP     CONIN
      C JMP     CONOUT
      F JMP     LIST
        JMP     PUNCH
        JMP     READER
        JMP     HOME
        JMP     DRIVE
        JMP     SETTRK
        JMP     SETSEC
        JMP     SETDMA
        JMP     READ
        JMP     WRITE
        ;
        ;       DRIVE DESIGNATION IS DETERMINED BY THE HARDWARE CONFIGURATION
        ;
        ;
        ;       TABLE OF DRIVE TYPES
        ;       0 - NO DRIVE
        ;       1 - 800
        ;       2 - 400
        ;       3 - 850
        ;       4 - 450
        ;
DRIVEA  DB      2       ; DRIVE A
DRIVEB  DB      1       ; DRIVE B
DRIVEC  DB      1       ; DRIVE C
DRIVED  DB      0       ; DRIVE D
        ;
        ;
        ;
        ;
DRIVE   LXI     H,DSK
        MOV     A,M     ; WHAT WAS LAST NEXT DRIVE
        CMP     C       ; SAME ?
        RZ
```

```
        MOV     M,C     ; STORE NEXT DRIVE
        LXI     H,DRIVEA        ; BEGINNING OF DRIVE TABLE
        MVI     B,0
        DAD     B
        MOV     A,M     ; FIND DRIVE TYPE
        LXI     H,MEM2  ; LOCATION OF DISK PARAMETER BLOCK
        DCR     A
        JZ      DR800
        DCR     A
        JZ      DR400
        DCR     A
        JZ      DR850
        DCR     A
        JZ      DR400
        ;
        ;
        ;       DRIVE ERROR
DRVERR  LXI     H,MSS1
        CALL    MESAG
        RET
MSS1    DB      CR,LF,'DRIVE SELECT ERROR',LF,CR,0
        ;
        ;       MINI 400 DRIVE
DR400   MVI     M,18    ; SECTORS PER TRACK
        INX     H
        MVI     M,63    ; MAXIMUM DIRECTORY NUMBER
        INX     H
        MVI     M,3     ; 2**3=8 SECTORS PER TRACK
        INX     H
        MVI     M,7     ; 2**3-1
        INX     H
        MVI     M,71    ; NUMBER OF BLOCKS
        JMP     DR4A
        ;
        ;       MINI 450 DRIVE
DR450   MVI     M,18    ; NUMBER OF SECTORS
        INX     H
        MVI     M,63    ; MAXIMUM DIRECTOR NUMBER
        INX     H
        MVI     M,3     ; 2**3=8 SECTORS PER BLOCK
        INX     H
        MVI     M,7     ; 2**3-1
        INX     H
        MVI     M,149   ; NUMBER OF BLOCKS
DR4A    INX     H
        MVI     M,0C0H  ; RESERVE 2 BLOCKS FOR DIRECTORY
        INX     H
        MVI     M,3     ; NUMBER OF SYSTEM TRACKS
        LXI     H,TRAN4
        SHLD    MEM1    ; TRANSLATE LOGICAL TO PHYSICAL SECTOR MAP
        MVI     A,1
        STA     DRTYPE  ; TELL PROM THIS IS A MINI DRIVE
        RET
        ;
TRAN4   DB      1,5,9,13,17
        DB      3,7,11,15,2,6,10
        DB      14,18,4,8,12,16,0
        ;
        ;       800 DRIVE
DR800   MVI     M,26    ; SECTORS PER TRACK
```

```
        INX     H
        MVI     M,63    ; MAXIMUM DIRECTORY NUMBER
        INX     H
        MVI     M,3     ; 2**3=8 SECTORS PER BLOCK
        INX     H
        MVI     M,7     ; 2**3-1
        INX     H
        MVI     M,242   ; NUMBER OF BLOCKS
        INX     H
        MVI     M,0C0H  ; RESERVE 2 BLOCKS FOR DIRECTORY
        JMP     DR8A
        ;
        ;       850 DRIVE
DR850   MVI     M,26    ; SECTORS PER TRACK
        INX     H
        MVI     M,63    ; MAXIMUM DIRECTORY NUMBER
        INX     H
        MVI     M,4     ; 2**4=16 SECTORS PER BLOCK
        INX     H
        MVI     M,0FH   ; 2**4-1
        INX     H
        MVI     M,246   ; NUMBER OF BLOCKS
        INX     H
        MVI     M,80H   ; RESERVE 1 BLOCK FOR DIRECTORY
DR8A    INX     H
        MVI     M,2     ; NUMBER OF SYSTEM TRACKS
        LXI     H,TRAN8
        SHLD    MEM1    ; TRANSLATE LOGICAL TO PHYSICAL SECTOR MAP
        XRA     A
        STA     DRTYPE  ; TELL PROM THIS IS A BIG DISK
        RET
        ;
TRAN8   DB      1,7,13,19,25,5,11,17
        DB      23,3,9,15,21,2,8,14
        DB      20,26,6,12,18,24,4,10
        DB      16,22,0
        ;
        ;
        ;       PROM ADDRESS
        ;
GOCPM   EQU     0F003H
WBOOT   EQU     0F006H
CONST   EQU     0F7FDH
CONIN   EQU     0F7FAH
CONOUT  EQU     0F7F7H
LIST    EQU     0F7F4H
PUNCH   EQU     0F7F1H
READER  EQU     0F7EEH
HOME    EQU     0F009H
SELDSK  EQU     0F00CH
SETTRK  EQU     0F00FH
SETSEC  EQU     0F012H
SETDMA  EQU     0F015H
READ    EQU     0F018H
WRITE   EQU     0F01BH
MESAG   EQU     0F7E8H
        ;
DISKT   EQU     044H    ; STORE CURRENT DRIVE
DSK     EQU     045H    ; STORE NEXT DISK DRIVE
DRTYPE  EQU     048H    ; STORE CURRENT DRIVE TYPE
```

```
;
CR      EQU     0DH
LF      EQU     0AH
        END     PATCH
```

```
;*****************************************************************************
;
;** DISK PARAMETER BLOCK
;
;** RELATIVE LOCATION 1AH
;
;** SINGLE DENSITY 800 DRIVE
;
;*****************************************************************************
;
        ORG     01AH
TRAN    DB      1,7,13,19,25,5,11,17
        DB      23,3,9,15,21,2,8,14
        DB      20,26,6,12,18,24,4,10
        DB      16,22
        DB      0,0,0,0,0,0
SECSIZ  DB      26          ; SECTORS PER TRACK
DIRMAX  DB      63          ; MAXIMUM DIRECTORY SIZE 2*8*4-1
BLKSHF  DB      3           ; SECTORS PER BLOCK 2**3
BLKMSK  DB      7           ; BLOCK MASK 2**3-1
MAXALL  DB      242         ; MAXIMUM BLOCKS PER DISK
DIRBLK  DB      0C0H        ; RESERVE 2 BLOCKS FOR DIRECTORY
OSTRKS  DB      2           ; NUMBER OF OPERATING SYSTEM TRACKS
;
;*****************************************************************************
;** END OF DISK PARAMETER BLOCK
;*****************************************************************************

A>
A>
;*****************************************************************************
;
;** DISK PARAMETER BLOCK
;
;** RELATIVE LOCATION 1AH
;
;** SINGLE DENSITY 400 DRIVE
;
;*****************************************************************************
;
        ORG     01AH
TRAN    DB      1,5,9,13,17
        DB      3,7,11,15,2,6,10
        DB      14,18,4,8,12,16
        DB      0,0,0,0,0,0,0,0
        DB      0,0,0,0,0,0
SECSIZ  DB      18          ; SECTORS PER TRACK
DIRMAX  DB      63          ; MAXIMUM DIRECTORY SIZE 2*8*4-1
BLKSHF  DB      3           ; SECTORS PER BLOCK 2**3
BLKMSK  DB      7           ; BLOCK MASK 2**3-1
MAXALL  DB      70          ; MAXIMUM BLOCKS PER DISK
DIRBLK  DB      0C0H        ; RESERVE 2 BLOCKS FOR DIRECTORY
OSTRKS  DB      3           ; NUMBER OF OPERATING SYSTEM TRACKS
;
;*****************************************************************************
;** END OF DISK PARAMETER BLOCK
;*****************************************************************************
```

```
;*****************************************************************************
        ;       DISK SYSTEM PROM F000H
        ;       FOR CP/M 1.4
        ;       MULTI DRIVE INPUT 400,450,800,850
        ;       TOTAL SYSTEM BOOT MINI OR LARGE FLOPPY
  *****************************************************************************
        ;
        ;       JMP TABLE
        ORG     0F000H
        JMP     COLDBOT
        JMP     GOCPM
        JMP     WBOOT
        JMP     HOME
        JMP     SELDSK
        JMP     SETTRK
        JMP     SETSEC
        JMP     SETDMA
        JMP     READ
        JMP     WRITE
        JMP     READTRK
        JMP     WRITTRK
F024    ;       FIND OUT IF DISK SELECTED IS THERE
        ;       IF DISK IS THERE SEND TO TRACK 0
STAT    MOV     A,C
        OUT     DEVSEL
        EI
        LXI     D,1000H
        MVI     A,FINT
        OUT     COMM
X1A     DI
        MVI     A,SKZERO
        OUT     COMM
SX2     IN      STATUS
        ANI     85H
        SUI     TRK0
        RZ
SX3     DCX     D
        MOV     A,D
        ORA     E
        JNZ     SX2
        INR     A
        RET
        ;       SELECT DISK A
        ;       SETUP MEMORY BLOCK AT 45H-4FH
        ;       SEND DISK TO TRACK 0
STRSET  MOV     A,C
        OUT     DEVSEL
        XRA     A
        LXI     H,DISKT
        MOV     M,A
        INR     L
        MOV     M,A
        INR     L
        MOV     M,A
        INR     L
        INR     A
        MOV     M,A
        JMP     HOME
        ;       DO A COLD BOOT LOAD
```

```
        ;       FIND OUT IF A DISK IS MINI OR LARGE
COLDBOT LXI     SP,80H
        CALL    INITU   ; INITALIZE VIDEO AND OTHER HARDWARE
        LXI     H,MSS1
        CALL    MESAG
        MVI     A,0C9H  ; STORE RET AT RESTART 2 FOR DISK CONTROLLER
        STA     RSTRTN
ST1     CALL    CONIN   ; WAIT FOR DISK TO BE LOADED
        CPI     CR
        JNZ     ST1
        MVI     B,15    ; NUMBER OF TRIES TO SEE IF READY
ST2     MVI     C,0B3H  ; MINI DISK
        CALL    STAT
        JZ      ST3
        MVI     C,7EH   ; BIG DISK
        CALL    STAT
        JZ      ST4
        DCR     B
        JNZ     ST2
        LXI     H,MSS4
        CALL    MESAG   ; DISK NOT READY
        JMP     ST2     ; TRY AGAIN
ST3     INR     A       ; STORE A 1 FOR A MINI
ST4     STA     ADRV    ; STORE A 0 FOR A BIG DISK
        STA     DRTYPE
        PUSH    PSW
        CALL    STRSET
        LXI     H,80H
        SHLD    BFRPTR
        CALL    READ    ; READ SECTOR 1 TRACK 0
        LHLD    80H
        SHLD    BASECPM ; THE BASE OF CPM FIRST TO BYTES OF SECTOR 1
        LXI     H,082H  ; CP/M SYSTEM SIZE MESAG
        CALL    MESAG
        POP     PSW
        MVI     B,21    ; NUMBER OF SECTORS OF CP/M ON TKACK 1 BIG DISK
        JZ      WB2
        MVI     B,11    ; NUMBER OF SECTORS OF CP/M ON TRACK 2 MINI DISK
        JMP     WB2
        ;
        ;       SETUP FOR WARM BOOT
WBOOT   LXI     SP,80H
        LDA     ADRV    ; IS A DRIVE MINI OR BIG DISK
        STA     DRTYPE
        ORA     A
        MVI     C,7EH   ; BIG DISK DRIVE SELECT
        MVI     B,17    ; NUMBER OF SECTORS ON TRACK 1
        JZ      WB1
        MVI     C,83H   ; MINI DISK DRIVE SELECT
        MVI     B,7     ; NUMBER OF SECTORS ON TRACK 2
WB1     CALL    STRSET
WB2     PUSH    B
        MVI     C,2
        CALL    SETSEC
        LHLD    BASECPM
        SHLD    BFRPTR
        PUSH    H
        CALL    READTRK ; READ TRACK 0 STARTING FROM SECOND SECTOR
        MVI     C,1
        CALL    SETTRK
```

```
        CALL    SETSEC
        POP     H
        LXI     D,0C00H
        LDA     ADRV
        ORA     A
        JZ      WB8
        ;       MINI ONLY
        LXI     D,880H
        DAD     D
        SHLD    BFRPTR
        PUSH    D
        PUSH    H
        CALL    READTRK ; READ ALL OF TKACK 1 FOR MINI ONLY
        MVI     C,2
        CALL    SETTRK
        POP     H
        POP     D
WB8     DAD     D
        SHLD    BFRPTR
        POP     B
        MVI     C,0
        ;
        ;       READ THE NUMBER OF SECTORS IN REGESTER B ON LAST SYSTEM TRACK
WB9     INR     C
        PUSH    B
        CALL    SETSEC
        LHLD    BFRPTR
        LXI     D,80H
        DAD     D
        SHLD    BFRPTR
        CALL    READ
        POP     B
        MOV     A,B
        CMP     C
        JNZ     WB9
        LXI     D,0
        SUI     07H     ; WARM OR COLDBOOT ?
        ANI     04H
        JNZ     GO2
        ;
        ;       DONE WITH LOAD
        ;       SET UP WBOOT JMP AND BDOS JMP
        ;       SET UP DMA ADDRESS
        ;       JMP TO CCP FOR AUTO LOAD ON COLDBOOT
        ;       JMP TO CCP+3 ON WARMBOOT TO BYPASS AUTO LOAD
GOCPM   LXI     D,03H
GO2     MVI     A,0C3H
        STA     0
        STA     5
        LHLD    BASECPM
        LXI     B,0806H
        DAD     B
        SHLD    6
        LXI     B,0CFDH
        DAD     B
        SHLD    1
        LXI     B,80H
        CALL    SETDMA
        MVI     C,0
        LHLD    BASECPM
```

```
        DAD     D       ; JUMP TO CCP ON COLDBOOT OR CCP+3 ON WARM BOOT
        PCHL
        ;
        ;       SEE IF 1771 IS BUSY
        ;       IF BUSY FOR TOO LONG THE DISK IS NOT READY
        ;       THEN WAIT FOR DISK TO BECOME READY
  BY    PUSH    H
        LXI     H,0FFFFH
B1      IN      STATUS ——— 3 IN'S !
        ANI     81H
        JZ      B4
        DCX     H
        MOV     A,H
        ORA     L
        JNZ     B1
B2      LXI     H,MSS4
        CALL    MESAG
B3      IN      STATUS
        ANI     81H
        JNZ     B3
B4      POP     H
        RET
        ;
        ;       MOVE DISK HEAD TO TKACK 0
        ;       ON SELECTED DRIVE
HOME    PUSH    B
        CALL    DSKSEL
HM1     CALL    BUSY
        MVI     A,SKZERO
        OUT     COMM
        CALL    BUSY
        IN      STATUS
        ANI     TRK0
        JZ      HM1     ; NOT HOME TRY AGAIN
        POP     B
        RET
        ;       STORE NEXT DRIVE
SELDSK  MOV     A,C
        STA     DSK
        RET
        ;       STORE NEXT TRACK
SETTRK  MOV     A,C
        STA     TRK
        RET
        ;       STORE NEXT SECTOR
SETSEC  MOV     A,C
        STA     SEC
        RET
        ;
        ;       SEEK NEXT TRACK TO BE USED ——— CALL BUSY
SEEK    LDA     DRTYPE
        ORA     A       ; IS THIS A MINI OR BIG DISK,0=BIG,1=MINI
        LDA     TRK
        MOV     C,A
        JNZ     SEEK4
        ;
 EK8    CPI     77      ; BIG DISK ,SINGLE OR DOUBLE SIDED
        JC      SK1
        SUI     77
        MOV     C,A
```

```
        LDA     DISKT   ;CURRENT SELECTED DISK IF BIT 7 HIGH, ON SIDE TWO
        CPI     7FH
        JNC     SK3
        PUSH    B
        MVI     C,S2MASK8
        ORI     80H     ; SET BIT 7 HIGH
        JMP     SK2
SK1     LDA     DISKT   ;CURRENT SELECTED DISK IF BIT 7 IS ZERO ON SIDE ONE
        CPI     7FH
        JC      SK3
        PUSH    B
        MVI     C,S1MASK8
        ANI     0FH     ; SET BIT 7 LOW
SK2     STA     DISKT   ; STORE CURRENT DISK AND SIDE
        ANI     0FH     ; FIGURE BIT PATTERN FOR DRIVE SELECT
        RAL
        CMA
        ANA     C
        JMP     SK2A
        ;
SEEK4   CPI     35      ; MINI DISK SINGLE OR DOUBLE SIDED
        JC      SK1B
        SUI     35
        MOV     C,A
        LDA     DISKT   ; CURRENT DISK IF BIT 7 HIGH, ON SIDE TWO
        CPI     7FH
        JNC     SK3
        PUSH    B
        MVI     C,S2MASK4
        ORI     80H     ; SET BIT 7 HIGH
        JMP     SK2B
 1B     LDA     DISKT   ; CURRENT SELECTED DISK IF BIT 7 LOW, ON SIDE ONE
        CPI     7FH
        JC      SK3
        PUSH    B
        MVI     C,S1MASK4
        ANI     0FH     ; SET BIT 7 LOW
SK2B    STA     DISKT
        ANI     0FH
        CPI     1
        RAL
        RAL
        ORA     C
SK2A    OUT     DEVSEL  ; SELECT OTHER SIDE IF NEEDED
        POP     B
        ;
SK3     CALL    BUSY    ; SEE IF 1771 IS BUSY
        IN      TRACK   ; LOAD CURRENT TRACK, SEE IF ALREADY THERE
        SUB     C
        JNZ     SK4
        IN      STATHD  ; IS DISK HEAD STILL LOADED
        ANI     HDLOAD
        RZ              ; IF AT TRACK, AND HEAD IS LOADED RETURN
        ;
SK4     MOV     A,C     ; SEEK NEW TRACK
        OUT     DATA
        CALL    BUSY
        MVI     A,SKCOMM
        OUT     COMM
        CALL    BUSY
```

```
        IN      STATUS
        ANI     SKERR
        RZ              ; IF AT TRACK RETURN
        CALL    HOME    ; GO TO TRACK ZERO IF ERROR
        JMP     SK4     ; TRY TO FIND TRACK AGAIN
        ;
        ;       SETUP FOR NEXT READ OR WRITE
__TUP   SHLD    RSTRTN+1 ; STORE RESTART ADDRESS AT RESTART LOCATION
        MVI     A,0C3H
        STA     RSTRTN  ;STORE JMP AT RESTART LOCATION
        CALL    OSKSEL  ; SELECT WHICH DISK
        CALL    SEEK    ; SELECT NEXT TRACK
SP1     CALL    BUSY
        LDA     SEC
        OUT     SECTREG ; SELECT NEXT SECTOR
        JMP     BUSY
        ;
SETDMA  PUSH    H       ; STORE BEGINNING MEMORY LOCATION FOR READ OR WRITE
        LXI     H,BFRPTR
        MOV     M,C
        INX     H
        MOV     M,B
        POP     H
        RET
        ;
        ;       READ ONE TRACK
READ    LXI     H,RVCTR ; RESTART ADDRESS
        CALL    SETUP   ; SET DISK,TRACK,SECTOR FOR READ
        MVI     B,10    ; NUMBER OF TRIES
LUP1    MVI     A,RDCOMM        ; READ SECTOR
LUP1A   EI
        LHLD    BFRPTR
        OUT     COMM
LUP2    HLT             ; READ DATA TO ADDRESS IN H,L
        IN      DATA
        MOV     M,A
        INX     H
        JMP     LUP2
RVCTR   INX     SP      ; REMOVE INTERRUPT ADDRESS FROM STACK
        INX     SP
        IN      STATUS
        ANI     9CH
        OUT     0FFH    ; OUTPUT ERRORS TO PORT 255
        RZ              ; RETURN IF NO ERRORS
        DCR     B
        JNZ     LUP1
        MVI     A,1     ; AFTER 10 TRIES TELL CP/M BAD READ
        RET
        ;
        ;       READ A TRACK STARTING AT ANY SECTOR
READTRK MVI     B,10    ; NUMBER OF TRIES
LUP5    LXI     H,RVCTK ; RESTART ADDRESS
        CALL    SETUP   ; SET DISK TRACK AND STARTING SECTOR FOR READ
        MVI     A,RDTKCM        ; READ TRACK
        JMP     LUP1A   ; JUMP TO READ LOOP
RVCTK   INX     SP      ; REMOVE INTERRUPT ADDRESS FROM STACK
        INX     SP
        IN      STATUS
        ANI     08CH
        OUT     0FFH    ; OUTPUT ERRORS TO PORT 255
```

```
        RZ              ; RETURN NO ERRORS
        DCR     B
        JNZ     LUP5
        MVI     A,1     ; AFTER 10 TRIES TELL BAD READ
        RET
        ;
        ;       WRITE ONE SECTOR
WRITE   LXI     H,WVCTR ; RESTART ADDRESS
        CALL    SETUP   ; SET DISK TRACK SECTOR FOR WRITE
        MVI     B,10    ; NUMBER OF TRIES
LUP3    MVI     A,WRTCOM        ; WRITE SECTOR
LUP3A   EI
        LHLD    BFRPTR
        OUT     COMM
LUP4    MOV     A,M     ; WRITE DATA FROM ADDRESS IN H,L
        HLT
        OUT     DATA
        INX     H
        JMP     LUP4
WVCTR   INX     SP      ; REMOVE INTERRUPT ADDRESS FROM STACK
        INX     SP
        IN      STATUS
        ANI     0FCH
        OUT     0FFH    ; OUTPUT ERRORS OT PORT 255
        RZ              ; RETURN NO ERRORS
        ANI     40H     ; WRITE PROTECTED ?
        JZ      WR2
WR1     LXI     H,MSS3
        CALL    MESAG
        RET
WR2     DCR     B
        JNZ     LUP3
        MVI     A,1     ; AFTER 10 TRIES TELL BAD WRITE
        RET
        ;
        ; WRITE A TRACK STARTING FROM ANY SECTOR
WRITTRK MVI     B,10    ; NUMBER OF TRIES
LUP7    LXI     H,WVCTK ; RESTART ADDRESS
        CALL    SETUP   ; SET DISK TRACK AND STARTING SECTOR
        MVI     A,WTTKCM        ; WRITE TRACK
        JMP     LUP3A
WVCTK   INX     SP      ; REMOVE INTERRUPT ADDRESS FROM STACK
        INX     SP
        IN      STATUS
        ANI     0ECH
        OUT     0FFH    ; OUTPUT ERRORS TO PORT 255
        RZ              ; RETURN NO ERRORS
        ANI     40H     ; WRITE PROTECT ?
        JNZ     WR1
        DCR     B
        JNZ     LUP7
        MVI     A,1     ; AFTER 10 TRIES TELL OF BAD WRITE
        RET
        ;
        ; DRIVE SELECT, SIDE 1 ONLY
        ; IF DRIVE IS ALREADY SELECTED RETURN
KSEL    CALL    BSYLT   ; TURN BUSY LITE ON
        DI
        LXI     H,DISKT ; NEXT DISK DRIVE
        MOV     A,M
```

```
        ANI     0FH     ; LOWER 4 BITS ONLY
        INR     L
        MOV     C,M     ; NEXT DRIVE
        CMP     C
        RZ              ; NEXT AND CURRENT ARE SAME
        DCR     L
        MOV     M,C     ; STORE NEW CURRENT DRIVE
        LXI     H,ALTTRK
        PUSH    H
        ADD     L
        MOV     L,A
        IN      TRACK
        MOV     M,A     ; SAVE HEAD TRACK LOACTION OF OLD DRIVE
        LDA     DRTYPE  ; BIG OR MINI DRIVE IS NEXT TYPE OF DRIVE
        ORA     A
        MOV     A,C
        JZ      DS2
DS1     CPI     1       ; MINI DRIVE FIND BIT PATTERN FOR DRIVE SELECT
        RAL
        RAL
        ORI     S1MASK4
        JMP     DS3
DS2     RAL             ; BIG DRIVE FIND BIT PATTERN FOR DRIVE SELECT
        CMA
        ANI     S1MASK8
DS3     OUT     DEVSEL  ; SELECT NEW DRIVE
        POP     H
        MOV     A,C
        ADD     L
        MOV     L,A
        MOV     A,M
        OUT     TRACK   ; UPDATE TRACK REGISTER FOR PRESENT HEAD LOCATION
        RET
        ;
        ; MESSAGES
MSS1    DB      CL,'T/DOS VERSION 1.4'
        DB      CR,LF,'COPYRIGHT 1977-TEI,INC.',CR,LF
        DB      LF,'LOAD DISK & PRESS RETURN',0
MSS3    DB      BL,CR,LF,'WRITE PROTECTED',0
MSS4    DB      BL,CR,LF,'DISK NOT READY',CR,LF,0
        ;
        ; DATA BLOCH 40H-4FH
BASECPM EQU     040H    ; LOCATION OF ADDRESS FOR BASE OF CP/M
BFRPTR  EQU     042H    ; LOCATION OF ADDRESS FOR DMA BUFFER POINTER
DISKT   EQU     044H    ; STORE CURRENT DISK DRIVE
DSK     EQU     045H    ; STORE NEXT DISK DRIVE
TRK     EQU     046H    ; STORE NEXT TRACK
SEC     EQU     047H    ; STORE NEXT SECTOR
DRTYPE  EQU     048H    ; STORE CURRENT DRIVE TYPE
ALTTRK  EQU     049H    ; STORE DISK HEAD TRACK LOCATION OF OTHER DRIVES
                        ; 4 BYTES USED
ADRV    EQU     04DH    ; DRIVE TYPE OF DRIVE A
LFCNT   EQU     04FH    ; LINE FEED COUNT, NOT USED IN THIS PROGRAM
        ;
        ; DISK CONTROLLER PORTS
STATUS  EQU     080H    ; STATUS OUT
  MM    EQU     080H    ; COMMAND IN
TRACK   EQU     081H    ; TRACK IN/OUT
SECTREG EQU     082H    ; SECTOR IN
DATA    EQU     083H    ; DATA IN/OUT
```

```
DEVSEL  EQU     084H    ; DRIVE SELECT OUT
STATHD  EQU     084H    ; HEAD LOAD STATUS IN
        ; STATUS BITS
HDLOAD  EQU     001H    ; HEAD LOAD
SKERR   EQU     010H    ; SEEK ERROR DID NOT FIND TRACK AN SECTOR
TRK0    EQU     004H    ; HEAD IS AT TRACK ZERO
        ; DISK CONTROLLER COMMANDS
SKCOMM  EQU     01EH    ; FIND TRACK IN TRACK REGISTER
SKZERO  EQU     00EH    ; MOVE HEAD TO TRACK ZERO
RDCOMM  EQU     088H    ; READ SECTOR
WRTCOM  EQU     0A8H    ; WRITE SECTOR
RDTKCM  EQU     098H    ; READ TRACK
WTTKCM  EQU     0BCH    ; WRITE TRACK
FINT    EQU     0D8H    ; FORCE INTERRUPT IMMEDIATE
        ; SIDE AND DRIVE SELECT MASKS
S1MASK8 EQU     07EH    ; BIG DISK SIDE 1
S2MASK8 EQU     06EH    ; BIG DISK SIDE 2
S1MASK4 EQU     0B1H    ; MINI DISK SIDE 1
S2MASK4 EQU     0A1H    ; MINI DISK SIDE 2
        ;
RSTRTN  EQU     010H    ; RESTART TWO LOCATION FOR CONTROLLER
        ; ADDRESS IN I/O PROM F400H
BSYLT   EQU     0F7E5H  ; TURN ON BUSY LIGHT ON TEI KEYBOARD
INITU   EQU     0F7E8H  ; INITILIAZE HARDWARE
MESAG   EQU     0F7EBH  ; OUTPUT MESSAGE TO VIDEO
CONOUT  EQU     0F7F7H  ; OUTPUT CHARACTER
CONIN   EQU     0F7FAH  ; INPUT CHARACTER
        ; VIDEO CONTROL CHARACTERS
CR      EQU     0DH     ; CARRAGE RETURN
LF      EQU     0AH     ; LINE FEED
        EQU     1AH     ; CLEAR SCREEN
        EQU     07H     ; RING BELL
        END     0F000H
```

```
;*****************************************************************************

        SAMPLE NON-STANDARD SYSTEM I/O FOR CP/M

;*****************************************************************************
START   EQU     0F400H
        ORG     START
        ;
        ;
        ;       IOBYTE
        ;
        ;       BITS 0,1 - CONSOLE
        ;       0 - TTY
        ;       1 - CRT
        ;       2,3 - CRT SCREEN AND LIST DEVICE
        ;
        ;       BITS 2,3 - READER
        ;       0 - CONIN TTY
        ;       1,2,3 - NOT USED
        ;
        ;       BITS 4,5 - PUNCH
        ;       0 - TTY
        ;       1,2,3 - NOT USED
        ;
        ;       BITS 6,7
        ;       0 - TTY
        ;       1 - CRT
        ;       2,3 - PARALLEL PRINTER
        ;
        ;
        ;       SAMPLE STATUS RETURN AN FF IN A IF
        ;       CHARACTER IS READY
        ;       RETURN AN 00 IF NO CHARACTER IS READY
CONST   IN      0STAT
        ANI     INSB
        JNZ     CT2
        CMA
        ORA     A
        RET
CT2     XRA     A
        RET
        ;       READ NEXT CONSOLE CHARACTER INTO REGISTER A
        ;       WAIT UNTIL CHARACTER IS TYPED BEFORE RETURNING
CONIN   CALL    CONST
        JZ      CONIN
        IN      0DATA
        ANI     MASK
        RET
        ;       OUTPUT CHARACTER TO DISPLAY DEVICE
CONOUT  LDA     IOBYTE
        ANI     03H
        JZ      TTY
        CPI     01H
        CNZ     LIST
VID1    IN      0STAT
        ANI     OTSB
        JNZ     CONOUT
```

```
        MOV     A,C
        OUT     DDATA
        RET
        ;       FIND WHICH PRINTER TO USE I/O BYTE, USE BITES 6,7
        ;       00 IS TTY
        ;       11 IS PARALLEL PRINTER
        ;       01 IS CONSOL OUTPUT
        ;       SEND CHARACTER IN CREGISTER TO PRINTER
        ;       GO INTO DELAY FOR LINE FEED ON TTY
        ;       COUNT NUMBER OF LINE FEEDS, ZERO FOR FORM FEED
LIST    LDA     IOBYTE
        ANI     0C0H
        JNZ     LI2
TTY     IN      WSTAT
        ANI     INSB
        JZ      TTY
        MOV     A,C
        OUT     WDATA
        CPI     0CH
        JZ      LI4
        CPI     0DH
        RNZ
        PUSH    H
        LXI     H,PDLAY
LI1     DCX     H
        MOV     A,H
        ORA     L
        JNZ     LI1
LI3     LXI     H,LFCNT
        MOV     A,M
        INR     A
        MOV     M,A
        POP     H
        RET
LI2     CPI     40H
        JZ      VID1
PARLL   IN      PSTAT
        ANI     02H
        JNZ     PARLL
        MOV     A,C
        OUT     PDATA
        XRA     A
        OUT     PSTROB
        INR     A
        OUT     PSTROB
        MOV     A,C
        CPI     0CH
        JZ      LI4
        CPI     0AH
        RNZ
        PUSH    H
        JMP     LI3
LI4     XRA     A
        STA     LFCNT
        RET
        ;       START OF MESSAGE ADDRESS IN H,L REGISTERS
        ;       MESSAGE ENDS WITH A NOP 00
MESAG   PUSH    B
MS2     MOV     A,M
        ORA     A
```

```
        JZ      MS1
        MOV     C,A
        CALL    CONOUT
        INX     H
        JMP     MS2
1       POP     B
        RET
        ;       INITIALIZE USART AND OTHER HARDWARE ON START UP
INITU   MVI     A,8AH
        OUT     PINIT
        XRA     A
        OUT     WSTAT
        OUT     WSTAT
        OUT     WSTAT
        INR     A
        OUT     PSTROB
        MVI     A,40H
        OUT     WSTAT
        MVI     A,0CEH
        OUT     WSTAT
        MVI     A,27H
        OUT     WSTAT
        MVI     A,IODATA
        STA     IOBYTE
        RET
        ;       NOT USED
BSYLT   RET
XYPLOT  RET
        ;       PUNCH AND READER USE ONLY TTY AND CONSOL INPUT
        ;       OTHER OPTIONS NOT USED
INCH    LDA     IOBYTE
        ANI     30H
        JZ      TTY
NXM     PUSH    H
        LXI     H,MSS10
        CALL    MESAG
        POP     H
        RET
READER  LDA     IOBYTE
        ANI     0CH
        JZ      CONIN
        JMP     NXM
        ;
MSS10   DB      0DH,0AH,'I/O DEVICE NONEXISTENT',0DH,0AH,0
        ;
        ;
IOBYTE  EQU     03H     ; IOBYTE LOCATION
IODATA  EQU     0C1H    ; INITIAL VALUE OF IOBYTE,
                        ; CRT,TTY,TTY,PARALLEL PRINTER
PINIT   EQU     07H     ; PARALLEL INIT.
LFCNT   EQU     04FH    ; LOCATION OF LINE FEED COUNTS
PSTROB  EQU     06H     ; PARALLEL DATA STROBE
PSTAT   EQU     05H     ; PARALLEL STATUS PORT
PDATA   EQU     04H     ; PARALLEL DATA PORT
CSTAT   EQU     00H     ; CONSOLE STATUS FOR I/O
CDATA   EQU     01H     ; CONSOLE DATA PORT FOR I/O
MASK    EQU     7FH     ; USED TO FORCE HIGH PARITY BIT TO ZERO
INSB    EQU     01H     ; STATUS BIT FOR KEYBOARD READY
OTSB    EQU     80H     ; STATUS BIT FOR OUTPUT READY
WSTAT   EQU     03H     ; PRINTER STATUS PORT FOR I/O
```

```
WDATA   EQU     02H     ; PRINTER I/O PORT FOR DATA
PDLAY   EQU     8000H   ; LENGTH OF DELAY LOOP FOR
                        ; PRINTER CARRAGE RETURN
        ;
        ;
        ;
        ;       JUMP    TABLE FOR SYSTEM I/O
        ORG     0F7E2H
        JMP     XYPLOT
        JMP     BSYLT
        JMP     INITU
        JMP     MESAG
        JMP     READER
        JMP     PUNCH
        JMP     LIST
        JMP     CONOUT
        JMP     CONIN
        JMP     CONST
        END     START
```

```
;*****************************************************************************
;
;       SAMPLE VIDEO AND I/O DRIVER FOR TEI SYSTEM AND CP/M
;
;*****************************************************************************
START   EQU     0F400H
        ORG     START
        ;
        ;       IOBYTE
        ;
        ;       BITS 0,1 - CONSOLE
        ;       0 - TTY
        ;       1 - CRT SCREEN
        ;       2,3 - CRT SCREEN AND LIST DEVICE
        ;
        ;       BITS 2,3 - READER
        ;       0 - CONIN TTY
        ;       1,2,3 - NOT USED
        ;
        ;       BITS 4,5 - PUNCH
        ;       0 - TTY
        ;       1,2,3 - NOT USED
        ;
        ;       BITS 6,7 - LIST
        ;       0 - TTY
        ;       1 - CRT SCREEN
        ;       2,3 - PARALLEL PRINTER
        ;
        ;
        ;       CHARACTER TO BE OUTPUT IN C REGESTER
        ;       SAVE REGESTERS
        ;       ON RETURN RESTORE REGISTERS
VIDEO   CALL    BSYLT
        LDA     IOBYTE
        ANI     03H
        JZ      TTY
        CPI     01H
        CNZ     LIST
VID1    PUSH    H
        PUSH    D
        PUSH    B
        CALL    SCREEN
        POP     B
        POP     D
        POP     H
        RET
        ;       CHECK FOR CONTROL CHARACTERS
SCREEN  MOV     A,C
        ANI     MASK
        MOV     C,A
        CPI     7FH     ; DELETE NOT USED
        RZ
        CPI     1       ; TURN CURSOR ON OFF
        JZ      CURT
        CPI     1AH     ; CLEAR SCREEN PROGRAM VIDEO
        JZ      CLR
        CPI     11H     ; CLEAR SCREEN LEAVE PROTECTED FIELDS
        JZ      PCLR
        CPI     12H     ; TURN ON/OFF PROTECTED FIELD OUTPUT
```

```
        JZ      PFLD
        CPI     0DH     ; CARRAGE RETURN
        JZ      CRET
        CPI     0AH     ; LINE FEED
        JZ      LFED
        CPI     08H     ; BACK SPACE CURSOR
        JZ      BS
        CPI     0BH     ; MOVE CURSOR UP ONE LINE
        JZ      VT
        CPI     0CH     ; MOVE CURSOR RIGHT ONE SPACE
        JZ      CUR
        CPI     20H     ; NO MORE CONTROL CHARACTERS
        RC
        ;
        ;       FIND CURSOR POSITION AND OUTPUT CHARACTER
        ;       IF CHARACTER AT CURSOR POSITION HAS
        ;       BIT 8 HIGH IT IS PROTECTED
        ;       MOVE CURSOR TO NEXT POSITION AND
        ;       TRY AGAIN
CHOUT   CALL    LADD
        CALL    RCHRCT
        DCR     A
        CALL    CRADD
        MOV     A,M
        ANI     80H
        JZ      CU3
        CALL    RCHRCT
        CPI     80
        RZ
        CALL    CUR
        JMP     CHOUT
        ;       SET PROTECTED FIELD BIT IF NEEDED
CU3     LDA     PBIT
        ORA     A
        JZ      CU4
        MOV     A,C
        ORI     80H
        MOV     C,A
CU4     MOV     M,C
        ;       MOVE CURSOR TO NEXT LOCATION
CUR     CALL    RCHRCT
        CPI     80
        JZ      CRLF
        INR     A
        CALL    LCHRCT
        RET
        ;       DO A CARRIAGE RETURN AND LINE FEED
CRLF    CALL    CRET
        CALL    LFED
        RET
        ;       DO A CARRIAGE RETURN
CRET    MVI     A,1
        CALL    LCHRCT
        RET
        ;       FIND FIRST MEMORY LOCATION OF CURRENT LINE
LADD    IN      RLIN
LAD2    LXI     H,VBASE
LD1     LXI     D,140H
LD2     CPI     4
        JC      LD3
```

```
        DAD     D
        SUI     4
        JMP     LD2
LD3     LXI     D,10H
        ORA     A
        RZ
LD4     DAD     D
        DCR     A
        JNZ     LD4
        RET
        ;       ADD THE CHARACTER OFFSET ADDRESS TO
        ;       THE H,L REGISTERS
CRADD   LXI     D,40H
CU1     CPI     10H
        JC      CU2
        DAD     D
        SUI     10H
        JMP     CU1
CU2     LXI     D,0
        MOV     E,A
        DAD     D
        RET
        ;       DO A LINE FEED SCROLL SCREEN IF NEEDED
LFED F4C6 LDA   CLRSCN
   F4C8 CPI     MXLIN-1
   F4CA JNZ     LF5
     C0 OUT     SCROL
LF2     IN      RLIN
        INR     A
        CPI     MXLIN
        JNZ     LF1
        XRA     A
LF1     OUT     LLIN
        CALL    CLRLIN
        RET
LF5   0E INR    A
        STA     CLRSCN
        JMP     LF2
        ;       BACK SPACE CURSER
BS      CALL    RCHRCT
        CPI     1
        RZ
        DCR     A
        CALL    LCHRCT
        RET
        ;       VERTICAL MOVE OF CURSOR
VT      IN      RLIN
        ORA     A
        JNZ     VT1
        MVI     A,MXLIN
VT1     DCR     A
        OUT     LLIN
        LDA     CLRSCN
        ORA     A
        JNZ     VT2
        MVI     A,MXLIN
VT2     DCR     A
        STA     CLRSCN
        RET
        ;       DELETE LAST CHARACTER
```

```
DEL     CALL    BS
        MVI     C,20H
        CALL    CHOUT
        CALL    BS
        RET
        ;       CLEAR THE CURRENT LINE
CLRLIN  IN      RLIN
        CALL    LADD
        LXI     D,30H
        MVI     C,5
CLN1    MVI     B,10H
CLN2    MOV     A,M
        ANI     80H
        JNZ     CNL3
        MVI     M,20H
CNL3    INX     H
        DCR     B
        JNZ     CLN2
        DAD     D
        DCR     C
        JNZ     CLN1
        RET
        ;       RESET CURSOR AND PROGRAM 5027
RESET   MVI     A,DHLNCNT
        OUT     HLNCNT
        MVI     A,DHSYNWT
        OUT     HSYNWT
        MVI     A,DSCNROW
        OUT     SCNROW
        MVI     A,DSKWBIT
        OUT     SKWBIT
        MVI     A,DSCNLIN
        OUT     SCNLIN
        MVI     A,DVRTDAT
        OUT     VRTDAT
        MVI     A,DLSTDRW
        OUT     LSTDRW
        OUT     STRTIM
        XRA     A
        STA     CLRSCN
        OUT     LLIN
        INR     A
        OUT     LCHR
        RET
        ;       CLEAR TOTAL SCREEN
        ;       SET SINK AREA
CLR     CALL    RESET
        LXI     H,VBASE
        LXI     B,SCNSIZ
CL1     MVI     M,20H
        INX     H
        DCX     B
        MOV     A,B
        ORA     C
        JNZ     CL1
        MVI     M,3
        INX     H
        MOV     A,H
        XRA     L
        JNZ     CL2
```

```
        XRA     A
        LXI     H,PBIT
        MOV     M,A
        INR     L
        MOV     M,A
        INR     L
        MOV     M,A
        RET
        ;       CLEAR PROTECTED SCREEN
PCLR    CALL    RESET
        LXI     H,VBASE
        LXI     B,SCNSIZ
PC1     MOV     A,M
        ANI     80H
        JNZ     PC2
        MVI     M,20H
PC2     INX     H
        DCX     B
        MOV     A,B
        ORA     C
        JNZ     PC1
        RET
        ;       SET THE PROCETED FIELD BIT
PFLD    LDA     PBIT
        CMA
        STA     PBIT
        RET
        ;       SET THE CURSOR TOGGEL BIT
CURT    LDA     CURSWT
        CMA
        STA     CURSWT
        ORA     A
        IN      RCHR
        JNZ     CT1
        SUI     80
        OUT     LCHR
        RET
CT1     ADI     80
        OUT     LCHR
        RET
        ;       READ CURSOR POSITION
        ;       SEE IF CURSOR IS ON/OFF
RCHRCT  LDA     CURSWT
        ORA     A
        IN      RCHR
        RZ
        SUI     80
        RET
        ;       OUTPUT CURSOR POSITION
        ;       SEE IF CURSOR IS ON/OFF
LCHRCT  MOV     B,A
        LDA     CURSWT
        ORA     A
        MOV     A,B
        JZ      LC1
        ADI     80
LC1     OUT     LCHR
        RET
        ;       PLOT X AND Y ,X=0-79,T=0-23
        ;       C REGESTER HAS CHARACTER AND D,E HAS X,Y
```

```
XYPLOT  PUSH    H
        PUSH    B
        PUSH    D
        MOV     A,E
        CPI     MXLIN
        JC      XY1
        MVI     A,MXLIN-1
XY1     CALL    LADZ
        POP     D
        PUSH    D
        MOV     A,D
        CPI     79
        JC      XY2
        MVI     A,79
XY2     CALL    CRADD
        POP     D
        POP     B
        MOV     M,C
        POP     H
        RET
        ;       SAMPLE STATUS RETURN AN FF IN A
        ;       IF CHARACTER IS READY
        ;       RETURN AN 00 IF NO CHARACTER IS READY
CONST   MVI     A,RDY
        OUT     BRLT
        IN      DSTAT
        ANI     INSB
        JNZ     CT2
        CMA
        ORA     A
        RET
CT2     XRA     A
        RET
        ;       READ NEXT CONSOLE CHARACTER INTO REGISTER A
        ;       WAIT UNTIL CHARACTER IS TYPED BEFORE RETURNING
CONIN   CALL    CONST
        JZ      CONIN
        CALL    BSYLT
        IN      DDATA
        ANI     MASK
        RET
        ;       FIND WHICH PRINTER USE I/O BITE ,USE BITES 6,7
        ;       00 IS TTY
        ;       01 IS CRT
        ;       11 IS PARALLEL "PRINTER
        ;       SEND CHARACTER IN C REGESTER TO THE PRINTER
        ;       GO INTO DELAY FOR LINE FEED ON TTY
LIST    CALL    BSYLT
        LDA     IOBYTE
        ANI     0C0H
        JNZ     LI2
TTY     IN      WSTAT
        ANI     INSB
        JZ      TTY
        MOV     A,C
        OUT     WDATA
        CPI     0CH
        JZ      LI4
        CPI     0AH
        RNZ
```

```
        PUSH    H
        LXI     H,PDLAY
LI1     DCX     H
        MOV     A,H
        ORA     L
        JNZ     LI1
LI3     LXI     H,LFCNT
        MOV     A,M
        INR     A
        MOV     M,A
        POP     H
        RET
LIZ     CPI     40H
        JZ      VID1
PARLL   IN      PSTAT
        ANI     02H
        JNZ     PARLL
        MOV     A,C
        OUT     PDATA
        XRA     A
        OUT     PSTR0B
        INR     A
        OUT     PSTR0B
        MOV     A,C
        CPI     0CH
        JZ      LI4
        CPI     0AH
        RNZ
        PUSH    H
        JMP     LI3
        XRA     A
        STA     LFCNT
        RET
        ;       OUTPUT MESSAGE TO THE VDM
        ;       START OF MESSAGE ADRESS IN H,L REGISTERS
        ;       MESSAGE ENDS WITH A NOP 00
MESAG   PUSH    B
MS2     MOV     A,M
        ORA     A
        JZ      MS1
        MOV     C,A
        CALL    VIDEO
        INX     H
        JMP     MS2
MS1     POP     B
        RET
        ;       TURN THE BUSY LIGHT ON FOR TEI KEYBOARD
BSYLT   MVI     A,BSY
        OUT     BRLT
        RET
        ;       INITIALIZE USART AND OTHER HARDWARE ON START UP
        ;       SET IOBYTE AND LINE FEED COUNT
INITU   MVI     A,8AH
        OUT     PINIT
        XRA     A
        STA     LFCNT
        OUT     0FFH
        OUT     WSTAT
        OUT     WSTAT
        OUT     WSTAT
```

```
        INR     A
        OUT     PSTROB
        MVI     A,40H
        OUT     WSTAT
        MVI     A,0CEH
        OUT     WSTAT
        MVI     A,27H
        OUT     WSTAT
        MVI     A,0C1H
        STA     IOBYTE
        RET
        ;       PUNCH AND READER USE ONLY TTY AND CONSOL INPUT
        ;       OTHER OPTIONS NOT USED
PUNCH   LDA     IOBYTE
        ANI     30H
        JZ      TTY
NXM     PUSH    H
        LXI     H,MSS10
        CALL    MESAG
        POP     H
        RET
READER  LDA     IOBYTE
        ANI     0CH
        JZ      CONIN
        JMP     NXM
        ;
MSS10   DB      0DH,0AH,'I/O DEVICE NONEXISTENT',0DH,0AH,0
        ;
        ;
        ;       I/O PORTS FOR VIDEO CONTROLLER
        ;
HLNCNT  EQU     90H
HSYNWT  EQU     91H
SCNROW  EQU     92H
SKWBIT  EQU     93H
SCNLIN  EQU     94H
VRTDAT  EQU     95H
LSTDRW  EQU     96H
RLIN    EQU     98H
RCHR    EQU     99H
RSET    EQU     9AH
SCROL   EQU     9BH
LCHR    EQU     9CH
LLIN    EQU     9DH
STRTIM  EQU     9EH
        ;       INITIAL PROGRAM DATA FOR VIDEO
DHLNCNT EQU     100
DHSYNWT EQU     37
DSCNROW EQU     69
DSKWBIT EQU     87
DSCNLIN EQU     3
DVRTDAT EQU     20
DLSTDRW EQU     23
        ;
 LIN    EQU     24      ; MAX NUMBER OF LINES ON VIDEO
 NSIZ   EQU     MXLIN*80 ; NUMBER OF BYTES OF SCREEN MEMORY
VBASE   EQU     0F800H  ; BASE OF SCREEN MEMORY
PBIT    EQU     0FFDCH  ; LOCATION OF PROTECTED FIELD FLAG
CLRSCN  EQU     0FFDDH  ; LOCATION OF LINE COUNTER
CURSWT  EQU     0FFDEH  ; LOCATION OF CURSOR ON/OFF FLAG
```

reversed?

```
IOBYTE  EQU     03H     ; LOCATION OF IOBYTE
DSTAT   EQU     00H     ; CONSOL STATUS PORT
DDATA   EQU     01H     ; CONSOLE DATA PORT
MASK    EQU     7FH     ; SET PARITY BIT TO ZERO
NSB     EQU     01H     ; STATUS BIT FOR KEYBOARD READY
SB      EQU     80H     ; STATUS BIT FOR OUTPUT READY
WSTAT   EQU     03H     ; SERIAL PRINTER STATUS AND PROGRAM PORT
WDATA   EQU     02H     ; SERIAL PRINTER I/O PORT
PINIT   EQU     07H     ; PARALLEL PROGRAM PORT
PSTROB  EQU     06H     ; PARALLEL DATA STROBE PORT
PSTAT   EQU     05H     ; PARALLEL STATUS PORT
PDATA   EQU     04H     ; PARALLEL DATA PORT
PDLAY   EQU     8000H   ; LENGTH OF DELAY LOOP
BRLT    EQU     01H     ; TEI BUSY/READY LIGHT PORT
BSY     EQU     02H     ; BUSY LIGHT ON
RDY     EQU     01H     ; READY LIGHT ON
LFCNT   EQU     04FH    ; LOCATION OF LINE FEED COUNT
        ;
        ;
        ;       JUMP    TABLE FOR SYSTEM I/O
        ;
        ORG     0F7E2H
        JMP     XYPLOT
        JMP     BSYLT
        JMP     INITU
        JMP     MESAG
        JMP     READER
        JMP     PUNCH
        JMP     LIST
        JMP     VIDEO
        JMP     CONIN
        JMP     CONST
        END     START
```